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A.C. Clarke

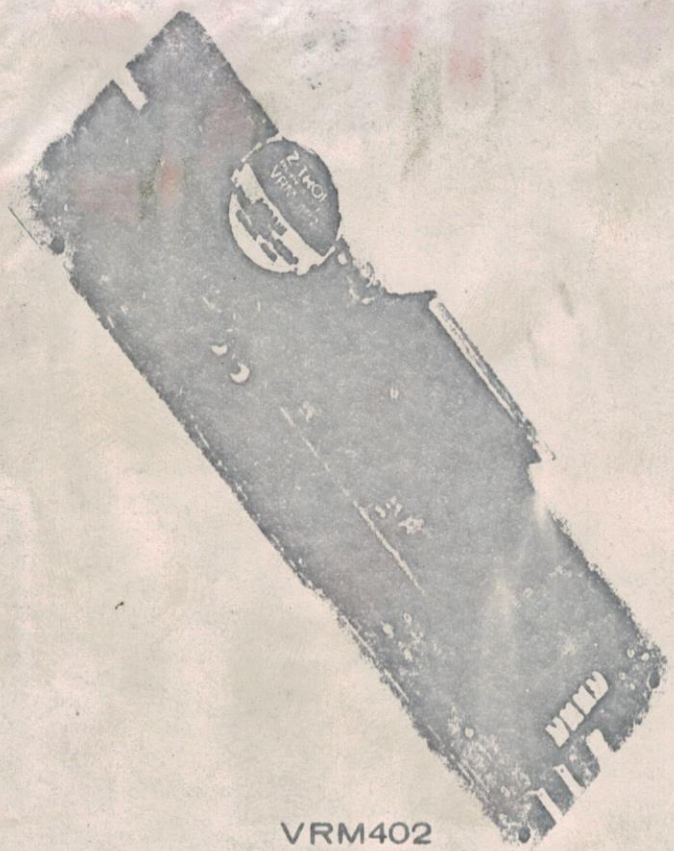
OCT 21 1974

LORAIN

Application Guide For

MODELS VRM402, VRM406 AND VRM407

VOICE FREQUENCY REPEATERS FOR SPECIAL SERVICE APPLICATIONS



VRM402

CALL DIVERTERS

WATS EXTENDERS LINES

ORDER WIRES

FIRE ALARM

ANY CIRCUIT REQUIRING HIGH GAIN WITH STABILITY

LORAIN PRODUCTS CORPORATION
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TABLE OF CONTENTS

PAGE

Section I

Description 1
Specifications 2
Simplified Schematic 4
Mounting Shelves and Accessories 5

Section II

Applications of Repeaters
on Special Services 6

Section III

Repeater Wiring 8
Sensitivity Options 9
Gain Chart 12
Installation Wiring 13

SECTION I

1. GENERAL

1.1 This section provides descriptions and specifications of Lorain VRM402, VRM406 and VRM407 Family of Voice Frequency Repeater for Special Service Applications.

1.2 Refer to Section II for various applications of the repeaters.

1.3 Refer to Section III for various types of installations, options for the sensitivity of the VRM402 and testing of the units.

2. DESCRIPTION

2.1 The Lorain VRM402, VRM406 and VRM407 are two-wire Voice Frequency Repeaters designed for terminal or intermediate application to extend the voice frequency range on Call Diverters, WATS extending circuits, conference bridges, order wire circuits or any application requiring high dB gain output with "no sing" qualities.

2.2 The units contain series and shunt amplifiers used for gain and automatic impedance control. The unique impedance control circuitry of the Z-Trol® repeater eliminates need for line build out. This unit provides impedance matching in both directions simultaneously and automatically.

2.3 Transmission is provided in both directions simultaneously with the stronger signal receiving the adjusted gain and the weaker (opposite) signal receiving an equal amount of loss. The units have a quiet state which introduces 1dB loss in both directions when signals are not present or are down -45dBm. Repeater turn-on sensitivity can be altered on the VRM402 for extremely long loops by options described in Section III.

2.4 The repeater will amplify tone dialing signals in the presence of precise dial tone (350 Hz + 450 Hz) or standard dial tone (600 + 120 Hz) provided the dial tone levels are set at the standard level of -13dBm.

2.5 Product line description of Z-Trol® Voice Frequency Repeaters for Special Service Applications.

2.5.1 **Fixed Gain**

Model VRM406 – Fixed 10dB gain for -48V operation
Model VRM407 – Fixed 10dB gain for -24V operation

Adjustable Gain ("It's a Snap")

Model VRM402 – gain adjustable from 5 to 20dB in 1dB steps and arranged for either -24 or -48V operation.

3. SPECIFICATIONS

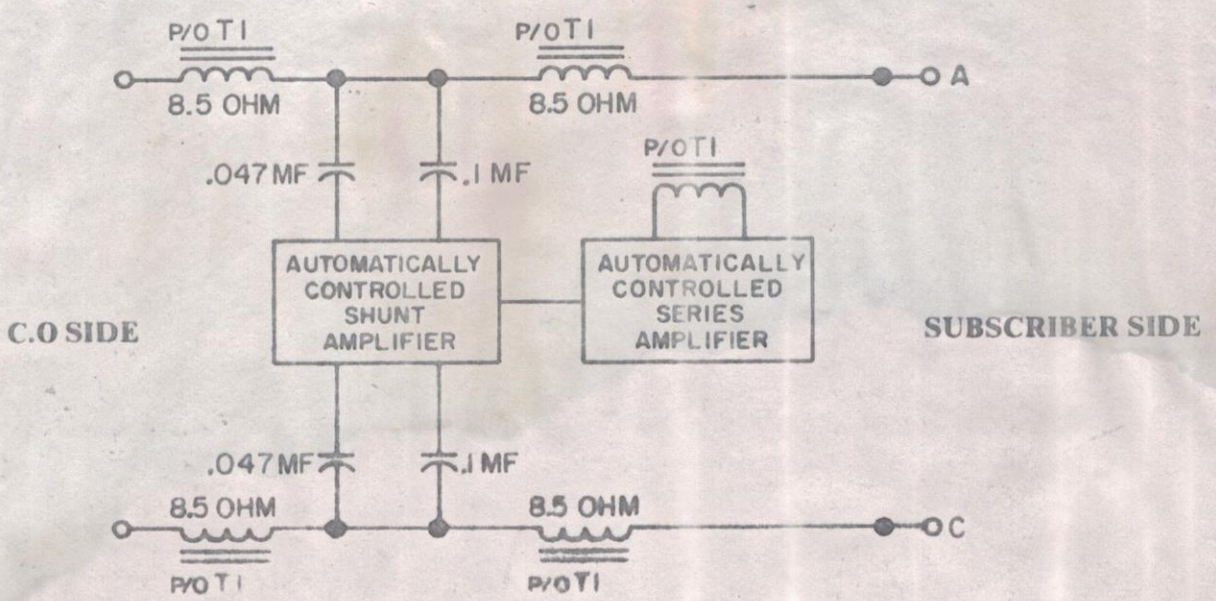
3.1 The special service family of voice frequency repeater performance specifications are listed in Table 1 below.

TABLE I

SPECIFICATION	DESCRIPTION
Gain	Models VRM406 and VRM407 have 10dB fixed gain. Model VRM402 is manually adjustable by snap switch from 5 to 20dB in one dB steps. Snap switch positions 1 thru 4 have gain values 1, 2, 4 and 8dB respectively, which adds to the 5dB (min) already in the repeater. See gain chart in Section III.
Load Scheme **End Section** **Gauge**	Models VRM402, 406 and 407, because of their impedance function, will perform on either D-66 or H88 loading. The repeaters will perform on non-loaded cable but high frequency roll-off can be expected. End sections and load coil spacing are not critical on these repeater models. All models will perform on all cable gauges.
Power Required	Model VRM402 is designed for either 24 ±6 or 48 ±6 volt operation. The voltage is selected by wiring to appropriate pins on the connector. At -24 volt operation 20 mA is drawn. At -48 volt operation 30 mA is drawn. See Section III for installation wiring diagram. Model VRM406 is a 48 ±6 VDC unit and draws 30 mA current. Model VRM407 is a 24 ±6 VDC unit and draws 20 mA current.
DC Resistance	Model VRM402, 406 and 407 have a low 35 ohms added loop resistance which is fixed because of no line build out units.
DC Current Carrying Capacity	All Repeaters Short circuit current is 330 mA. Transformer saturation occurs at 120 mA. Nominal current is 60 mA.
Mutual Capacitance	All models have 0.07 mf capacitance tip to ring in the signaling frequency range.
Overload	Models VRM406 and 407 overload at +8 dBm output. Model VRM402 overloads at +12dBm.
Longitudinal Balance	Greater than 70dB for all models.

Distortion	Less than 1% harmonic distortion for all repeaters.
REPEATER Turn-on Sensitivity	VRM402 and Issue 2 of VRM406 and 407 have three options for altering the repeater turn-on sensitivity. **OPTION 1** (as shipped) has equal sensitivity on both sides of the repeater. The turn-on value is approximately -46dBm at 1 KHz. **OPTION 2** increases the subscriber sensitivity by approximately 8dB and decreases the C.O. side by 2dB for a net effect of 10dB difference. **OPTION 3** provides for full turn-on for subscriber when the C.O. side is idle. Option 3 is intended for long subscriber loops with short C.O. loops. Examples of this are VF order wire lines, and fire alarm circuits.
Cross Talk	All repeaters have greater than 100dB isolation between adjacent units within the same card frame.
Cross Ring	All units contribute less than 10V increase to cross ring due to lack of line build out components.
Echo Return Loss	VRM402 25dB at 20dB gain Better than 35dB at 5dB gain 1 KHz
Singing Point	[illegible] conditions.
Lightning Protection	[illegible] by [illegible] milliseconds.
Mounting	[illegible] are designed to [illegible] standard [illegible] card frame units [illegible] section). The VRM40[illegible] is drilled on four [illegible] mounting or [illegible] grommets to meet [illegible] specifications.
Connection	[illegible] connections to the repeater may be made either with the standard connector for Part No. [illegible] or by direct wiring to the drilled holes and pads on the circuit board. VRM40[illegible] See Section III for various mounting methods.

THE LORAIN Z-TROL® VFR SIMPLIFIED SCHEMATIC



This abbreviated schematic of the Lorain family of Z-Trol® Special Service VFR, should provide sufficient information when planning the use of the repeater. As can be seen, there is DC continuity through the repeater. The specification DC resistance value should be used in calculating the insertion loss for supervision purposes.

MOUNTING SHELVES AND ACCESSORIES

Single Card Frames

These mounting shelves are designed to accommodate all the standard 2-1/2" high voice frequency repeater cards of Lorain manufacture. In VFR applications which do not require signaling (loop extender) treatment, card frames only need be ordered. Specify Part #4245-024 terminal block adapter for VFR only applications. (See Below.)

Card Frame (Front View Cover Off)

Rear View Shown With Terminal Block Adapter #4245-024

CARD FRAMES FOR MOUNTING PLUG-IN VOICE FREQUENCY REPEATER CARDS

DESCRIPTION	STANDARD FEATURES			MODEL NUMBER	APPROX. SHIP. WT. (lbs.)
	RACK WIDTH	NO. OF CARD SOCKETS	TYPE OF SOCKET LINE TERMINATIONS		
Card Frame	19"	10	Individual	CF19A	9
			10 x 10 Blocks	CF19B	9
	23"	12	Individual	CF23A	12
			10 x 10 Blocks	CF23B	12

All card sockets in these units provide built-on automatic bypass

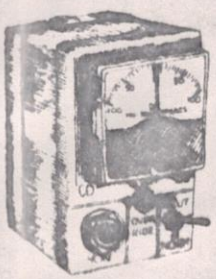
Edge Connector

Edge Connector Part Number 4233-331. The edge connector is available separately for independent mounting of the repeater.

Edge Connector Part #4233-331

Repeater Test Set

Model TS117 is an accessory for repeater testing and monitoring. This set has the capability of indicating the direction of amplification of the repeater, and of forcing the repeater in either direction or neutral for circuit net loss testing. There is a monitor point on the test set for circuit quality assurance.



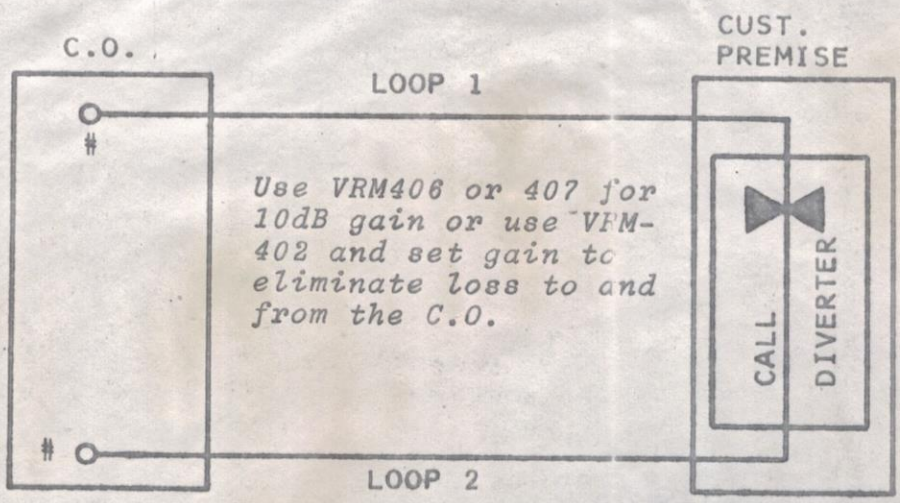
Repeater Test Set Model TS117

SECTION II

1. Application of the Z-Trol® Special Service Repeaters

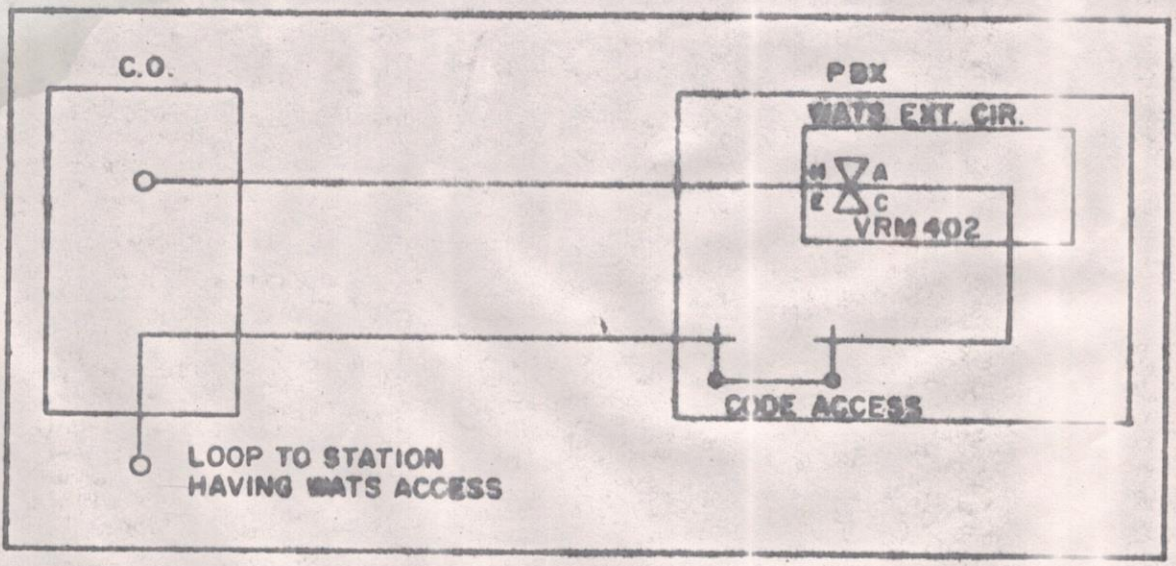
1.1 These repeaters were designed to fill a need for exceptionally stable high gain repeaters used in call diverters, WATS extender circuits, conference bridges, order wire circuits and the like. Of course, numerous other applications will arise where stable high gain is desired. The examples shown are to demonstrate the features of the repeater and are by no means intended to limit the repeater to these examples.

1.2 **Call Diverter Application**



The VRM402 turn-on sensitivities are shipped equal (i.e. Option 1). See Section III for a discussion on options for changing repeater turn-on sensitivity.

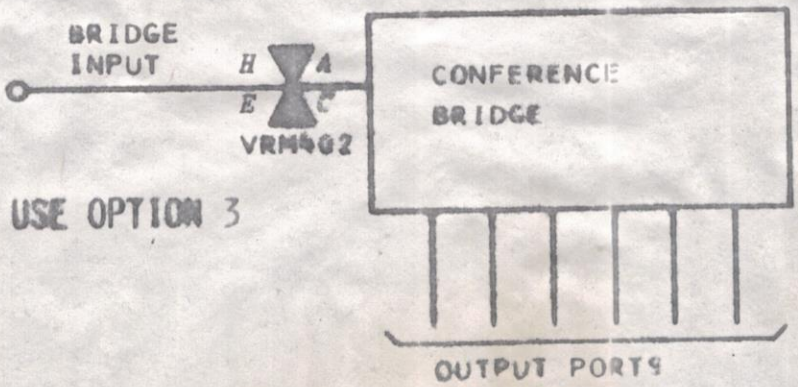
1.3 **WATS Extension Circuit Application**



In this application, the VRM402 is recommended because of the ability to give higher gain. Use Option 3, as described in Section III, to sensitize the subscriber side (i.e. terminals A & C) of the repeater for long loops.

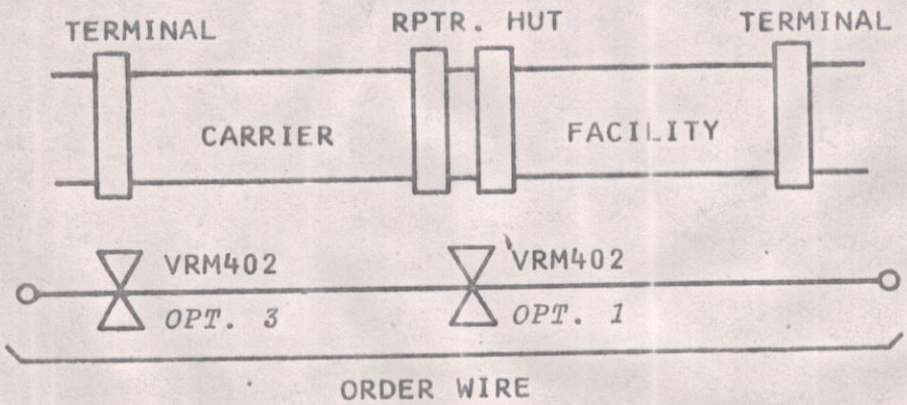
Also in Section III is an identification of the test pads on the "test end" of the repeater. It is here that connections may be made to "force" the repeater in a desired direction. For example, in tone dialing applications, it may be necessary to force the repeater in the subscriber direction in the presence of dial tone to assure that the first digit of tone dialing will be recognized.

1.4 Conference Bridges



The VRM402 is recommended in this application because of high gain ability and increased sensitivity on the conference bridge side of the repeater. Output ports may need treatment on long loops

1.5 Order Wire Circuits



Specify the VRM402 for order wire applications, when engineering carrier facilities. The VRM402 provides gain up to 20dB plus options for terminal or intermediate applications. See Section III for sensitivity option selection.

SECTION III

1. This section provides installation and wiring illustrations, description and selection of sensitivity options, gain setting instructions and testing of the VRM402, VRM406 and VRM407 repeater family.

1.1 Each of the repeater cards are designed to mount in Lorain Power Frames (PF) and Card Frames (CF) units shown in Section I Page 5. Also, edge connector, Part Number 4233-331, is available separately that can be mechanically mounted to support the card.

VRM402 has four (4) mounting holes drilled in the card and may be mounted on standoffs or grommets.

1.2 **Repeater Wiring**

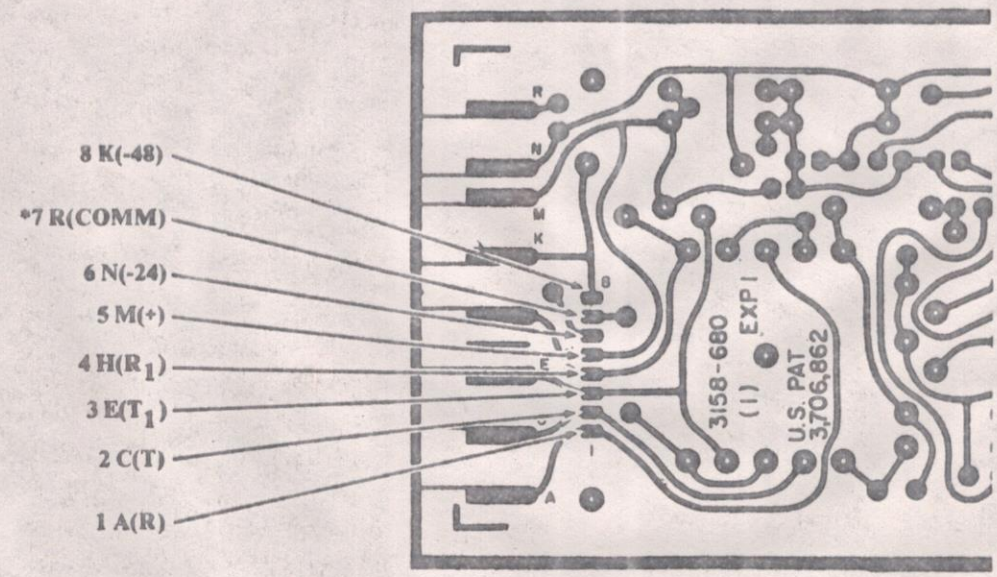
1.2.1 The VRM406 and VRM407 are designed to mount in edge connector, Part Number 4233-331, for wiring to the unit. Wiring figures are shown on Page 13 of this section.

Wiring by placing solder directly on the repeater card connector pads is not recommended because this destroys future ability to plug the repeater into a connector for testing if the unit is returned to our factory for repair.

Damage to the pads by soldering will invalidate our warranty.

1.2.2 The VRM402 may be wired by using edge connector, Part Number 4233-331 or wired direct to the card by soldering points provided on the card. The figure below shows the wiring points.

Solder Side of Board.
Transformer End.



*See Installer's Connection Figure 2 Page

1.3 **The VRM402 and issue 2 of VRM406 & 407 has three sensitivity options:**

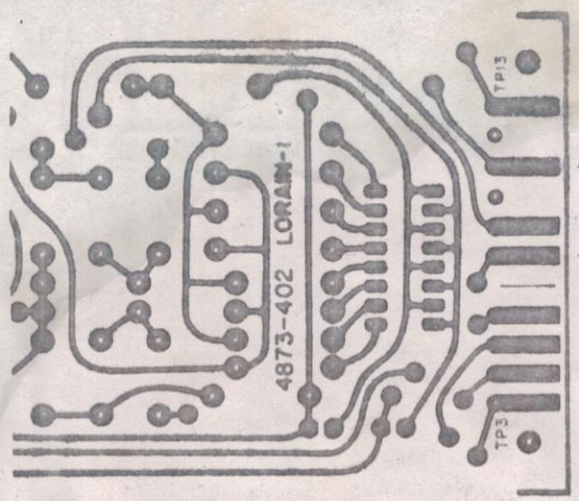
1.3.1 **OPTION 1** (as shipped) has equal turn-on sensitivity on both sides of the repeater. The power required to stimulate the repeater to the active state is about -46dBm at 1KHz.

1.3.2 **OPTION 2** will sensitize the subscriber side (i.e. Term A & C) of the repeater by approximately 10dB. Change resistor R26 on Drawing 4285-036 (Page 10) to 100K ohm resistor. (This resistor is supplied color coded Brown, Brown, Yellow, Gold.) This resistor is located on the upright "mini board" on the main repeater card and is plugged in. No soldering is necessary. Option 2 should be used to give the subscriber on long loops a 10dB advantage.

1.3.3 **OPTION 3** will provide maximum subscriber advantage by turning the repeater on in favor of the subscriber during idle condition. The C O side can still stimulate the repeater, but more power will be required to do so. This should be used on extremely long loops such as those presented by WATS extension and order wire circuits. Option 3 is accomplished by performing Option 2 plus adding a 1 meg ohm resistor at position "S" shown on Page 11. This resistor is placed on the main circuit board and is plugged in. This resistor is also supplied color coded Brown, Black, Green, Gold). Lower valued resistors may be used to strengthen the subscriber advantage. A 1K ohm resistor will "lock" the repeater in the subscriber favor.

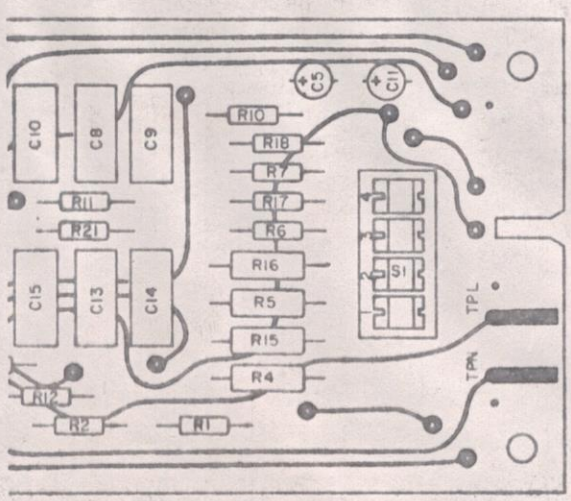
1.4 **Use of test points for special repeater applications.**

Solder pads are provided at some of the test points for special repeater applications. These points may be used to force the repeater in a desired direction at the users discretion. The following figures show these points.



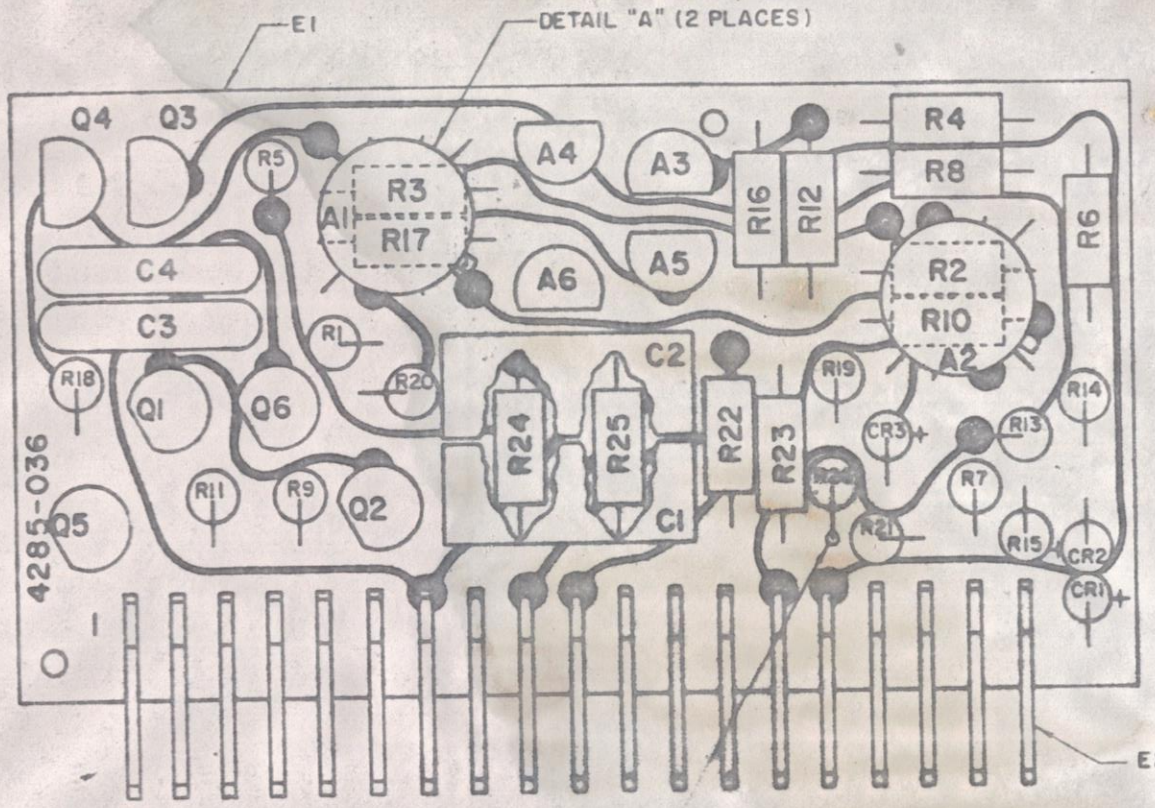
Solder Side Of Board

To force the Repeater in the subscribers favor, connect TP13 to TPN thru a 1K resistor.

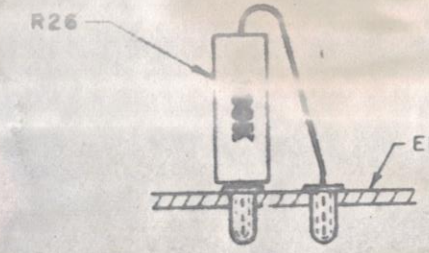


Component Side Of Board

To force the repeater in the central office favor connect TP3 to TPL thru 1K.

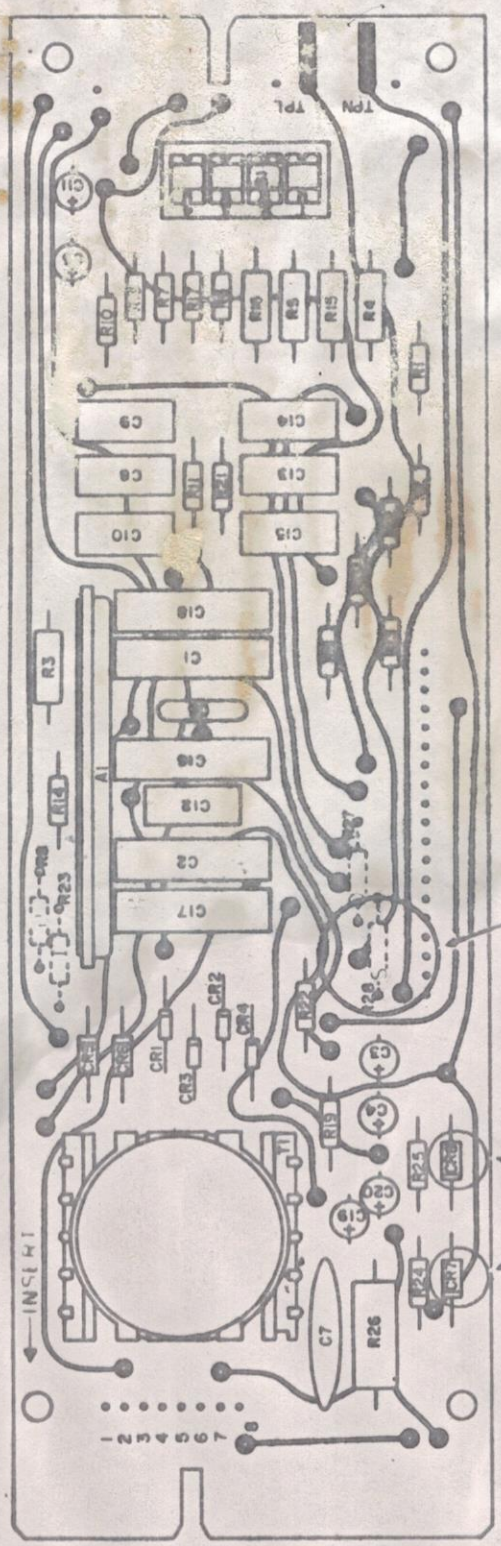


OPTION 2



PLUG-IN

4285-036



Resistor "S" (1 Meg)
For Option 3

For protection CR7 and CR8 are 15V Zeners (1N4744) that will blow open if 48V is applied to a -24V input on VRM402 and 407. If this occurs, replace diodes to restore card.

OPTION 3

1.5 VRM402 Repeater Gain Setting

1.5.1 The VRM402 is adjustable from 5 to 20dB in 1dB steps. Gain should be determined and then set per gain chart below.

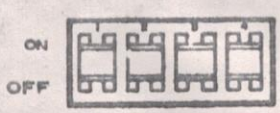
GAIN SETTING INSTRUCTIONS FOR
VRM 402 ADJUSTABLE GAIN VOICE
FREQUENCY REPEATER FOR SPECIAL
SERVICE APPLICATIONS

TO SET GAIN;

1) DETERMINE GAIN REQUIRED
2) SELECT GAIN ON CHART
3) SET SWITCH POSITIONS 1 THRU 4
   TO AGREE WITH THOSE ON THE
   CHART.

NOTE: A 5DB GAIN IS PRESENT
EVEN WHEN ALL SWITCHES
ARE IN THE OFF POSITION.

GAIN IN DB	SWITCH POSITION			
	1 1DB	2 2DB	3 4DB	4 8DB
5	OFF	OFF	OFF	OFF
6	ON	OFF	OFF	OFF
7	OFF	ON	OFF	OFF
8	ON	ON	OFF	OFF
9	OFF	OFF	ON	OFF
10	ON	OFF	ON	OFF
11	OFF	ON	ON	OFF
12	ON	ON	ON	OFF
13	OFF	OFF	OFF	ON
14	ON	OFF	OFF	ON
15	OFF	ON	OFF	ON
16	ON	ON	OFF	ON
17	OFF	OFF	ON	ON
18	ON	OFF	ON	ON
19	OFF	ON	ON	ON
20	ON	ON	ON	ON



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1.6 Testing

1.6.1 Each repeater is thoroughly tested before leaving the Lorain factory, but it is strongly recommended that repeaters be tested for gain before being permanently installed in equipment to be resold and shipped. This test may be conducted by some means derived by you or Lorain TS117 Test Set may be used. See Section I, Page 5 for a brief description of the TS117.

INSTALLATION OF LORAIN LOOP EXTENDER AND VOICE FREQUENCY REPEATER CARDS

General

The LORAIN Loop Extender and Voice Frequency Repeater plug-in circuit cards can be mounted in any LORAIN Power Frame (Loop Extender Basic Unit) or card frame.

Electrical Connections

Figure 1 below shows a typical card socket, detailing the electrical connections required for installing any Loop Extender card or Voice Frequency Repeater card.

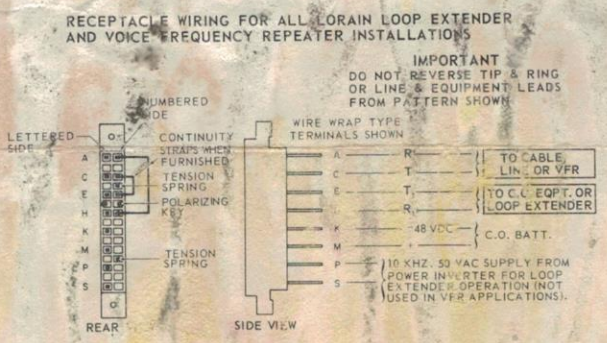

FIG. 1

When installing Loop Extender or Voice Frequency Repeater cards independently or in tandem, refer to the wiring diagram below, which corresponds to the type of installation desired.

1) LOOP EXTENDER OR VOICE FREQUENCY REPEATER CARDS CONNECTED INDEPENDENTLY

(A) STANDARD FRAME UTILIZING WIRE WRAP TERMINAL CONNECTIONS ON REAR OF CARD SOCKET

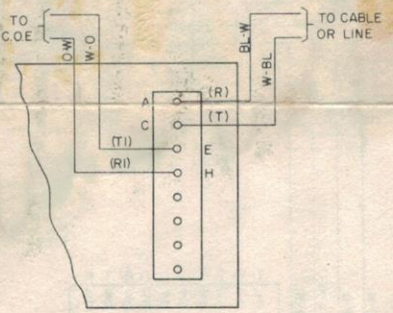

FIG. 2

(B) SPECIAL FRAME EQUIPPED WITH 10 X 10 TERMINAL BLOCK

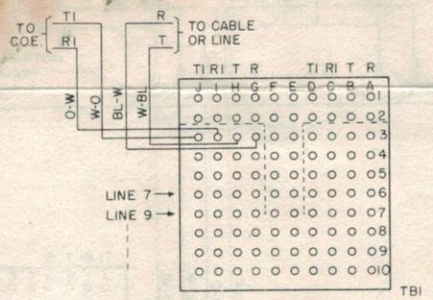

FIG. 3

2) LOOP EXTENDER AND VOICE FREQUENCY REPEATER INTERCONNECTIONS WHEN INSTALLED IN ALTERNATE CARD SOCKETS IN THE SAME FRAME (SIDE BY SIDE)

(A) STANDARD FRAME UTILIZING WIRE WRAP TERMINAL CONNECTIONS ON REAR OF CARD SOCKET

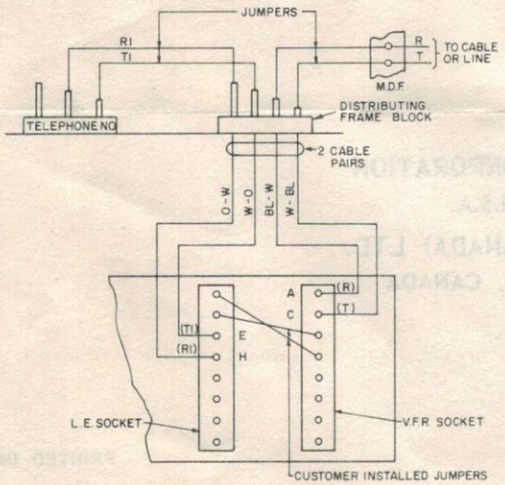

FIG. 4

(B) SPECIAL FRAME EQUIPPED WITH 10 X 10 TERMINAL BLOCK

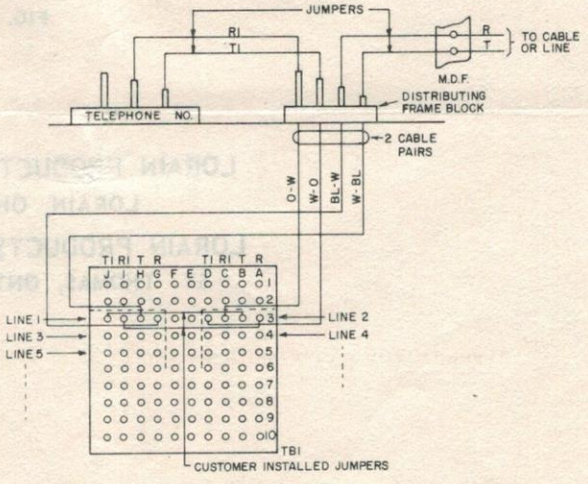

FIG. 5

3) LOOP EXTENDER AND VOICE FREQUENCY REPEATER INTERCONNECTIONS WHEN INSTALLED IN SEPARATE DEDICATED FRAMES

A) STANDARD FRAMES UTILIZING WIRE WRAP TERMINAL CONNECTIONS ON REAR OF CARD SOCKET

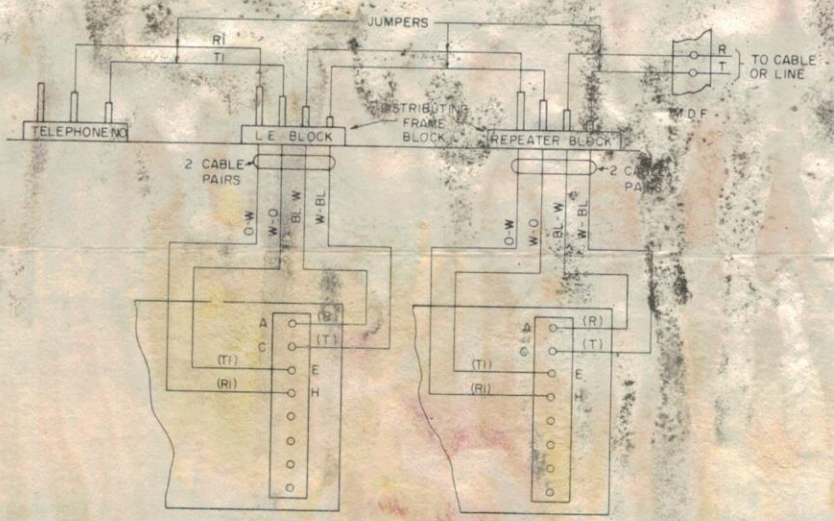

FIG. 6

B) SPECIAL FRAMES EQUIPPED WITH 10 X 10 TERMINAL BLOCKS

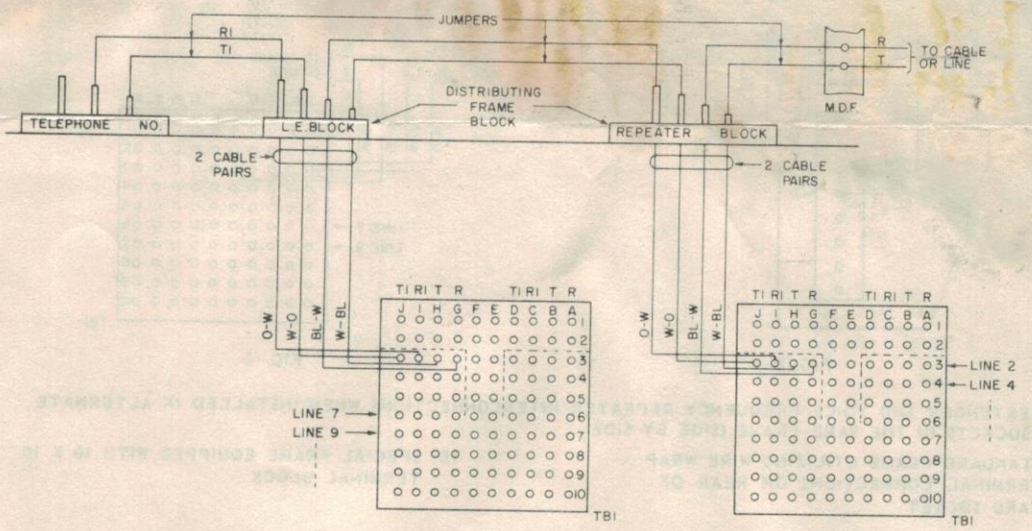

FIG. 7

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO, U.S.A.
LORAIN PRODUCTS (CANADA) LTD.
ST. THOMAS, ONTARIO, CANADA

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